Implementing Research Shared (Core) Facility Billing Systems

Ameet A. Chimote[1] Christopher Mayhew[2,3] Sherry Thornton[2,4] Cynthia Wetzel[2,5] Amanda N. White[6]

[1]Department of Internal Medicine, Division of Nephrology, University of Cincinnati, Cincinnati, Ohio 45267, USA,

[2]Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati, Ohio 45221, USA,

[3]and Division of Developmental Biology, Center for Stem Cell and Organoid Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio 45229, USA,

[4]and Division of Rheumatology, Research Flow Cytometry Core, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio 45229, USA,

[5]and Division of Gastroenterology, Hepatology, and Nutrition, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio 45229, USA,

[6]Cincinnati Children's Research Foundation, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio 45229, USA

ABSTRACT

Research Shared (core) Facilities (RSF) operate as centers of expertise and help to accelerate basic and translational science. A centralized platform for unified ordering, equipment reservation, and the billing of services using an integrated software system is a valuable resource that many academic institutions should consider. This paper discusses considerations for best practices and identifies lessons learned from the implementation of two different software systems for RSF. After implementing two different centralized billing systems for RSF, this paper identifies considerations for best practices and discusses lessons learned.

ADDRESS CORRESPONDENCE TO: Amanda Nicole White, Cincinnati Childrens Research Foundation, 3333 Burnet Avenue, Cincinnati, OH 45223 (Phone: 513-636-1481; E-mail: Amanda.White@cchmc.org).

INTRODUCTION

Research Shared (core) Facilities (RSF) make important contributions toward accelerating basic science and translational and clinical research at universities and institutes.[1],[2],[3],[4] These services provided by the RSFs are offered on a fee-for-service basis, often paid for by research grants and/or institutional support, to aid in the advancement of projects.[5],[6],[7] Centralized billing systems for RSF operations entered the market nearly a decade ago. Academic centers and nonprofit organizations overseeing RSF embraced the need for a software-based tool to manage billing processes and provide a more robust reporting of core activities.[8],[9],[10] The need for these tools often stem from administrators and RSF directors wanting to understand costs more fully within their organizations and implement mechanisms to aid their institutions in following the National Institutes of Health (NIH) and Office of Management and Budget (OMB) cost rate guidelines as enumerated in OMB Circular A-133.[11] This need also serves the larger stakeholder community in research academia, including individuals representing accounting, administration, information technology, RSF directors, division-level business managers, and some end users or laboratory members. Many institutions have developed in-house solutions or purchased commercially available software to aid in managing RSFs.

Fee structures for RSFs are developed annually following the OMB Circular A-133 cost rate guidelines.[12] In addition, some institutions develop rates using a template completed by each RSF and reviewed by a steering committee.[13],[6],[7] By implementing a centralized billing system, rates can be entered into the system and

managed by as few as one administrator. The centralized billing system ensures compliance and can meet stakeholder needs. End users or laboratory members can easily access and request services. Researchers are charged a uniform rate, and the billing format is consistent, allowing for easy review of their RSF charges. RSF directors, administrators, and business teams have access to reports on usage, revenue, and costs associated with RSFs.[8] The level of transparency on RSF usage and billing in the centralized software system and the comfort of knowing measures are in place to audit and institute the OMB Circular A-133 compliance guidelines minimize administrative burdens to all stakeholders.[12]

Many different types of centralized billing systems have been implemented for the management and oversight of RSF. Whether the billing system is developed in house or purchased from a vendor, the centralized billing system aims to track revenue and usage and strives to achieve the following goals: 1) reduce the administrative burden of billing from RSF directors and staff, 2) gain a better understanding of usage and revenue in each RSF, 3) ensure that an audit trail is in place for tracing charges to research grants (all transactions), 4) develop consistent billing practices across RSFs, 5) centralize and increase transparency of billing activity for all stakeholders within the system, and 6) provide a unified user experience for viewing and ordering services across RSFs.

Early phase project planning

After the selection of a centralized billing system to implement within the institution (develop in house or purchase one from a vendor) was determined, we began to plan and create the processes for the implementation. In the early phases of project planning, 3 main areas of focus were identified: organizational culture, technical considerations, and systemic workflow. To ensure our progress upheld the core values of Cincinnati Children's Hospital Medical Center (CCHMC), the project first needed to be built upon a foundation of respect, communication, teamwork, and the unified goal to make a difference. To achieve this, we established an essential team and outlined important team principles to guide the implementation process. Secondly, to ensure that the new system could be integrated seamlessly, the project required a thorough understanding of technical workflows, including existing financial and authentication systems. Finally, and perhaps most importantly, it was critical to assess each stakeholder's needs and desired outcomes to ensure preferred workflows for all roles could be attained using the new centralized billing system.[14],[15]

As with any major transition, the initial stages of implementation introduced changes to the current workflow and created uncertainty for some of the RSFs. However, with patience, persistence, and attentive engagement-building practices to address the RSF needs, we implemented a comprehensive ordering and billing system within our organizations' culture by addressing the needs and gaps from the perspectives of laboratory members, business roles, and RSFs.

Though these tools exist, and many stakeholders (vendors, software developers, administrators, RSFs) have been involved in developing these various platforms to aid in centralizing billing processes for RSFs, little has

been documented on how to implement centralized billing systems in RSFs that may not already be established within their institutions. This paper presents a multi-stakeholder narrative case study on CCHMC RSF experiences in the implementation of 2 different billing systems implemented over the last 7 years. Lessons that we learned from each implementation provide an overview of strategies that worked and did not work for our institution.

This manuscript aims to outline some considerations on implementing a centralized billing system to help manage billing and stakeholder needs and provide reference to strategic planning for implementing a billing system once a platform has been selected. This paper does not outline the project management components integral to consolidating user requirements, writing requests for proposals, or evaluating vendor responses for the selection of a centralized billing system. Nor does this paper intend to provide recommendations on which billing system to select for your organization but rather considerations that should be weighed when conducting your evaluation.

In sharing these perspectives, we anticipate other institutions may benefit from our lessons learned in implementing the 2 billing systems under different environmental conditions and gather insights from our first implementation of transitioning from paper-based billing to electronic billing and our second transition in migrating from one centralized billing system to another.

CCHMC shared facility portfolio

The RSFs housed within Cincinnati Children's Research Foundation (CCRF) are comprised of 25 facilities that are housed across 12 divisions within the Department of Pediatrics in the College of Medicine at the University of Cincinnati. With an annual revenue of over $40 million, these facilities are also subsidized by 2 NIH-funded P30 grants and provide services to research laboratories led by just over 500 principal investigators, out of which 10% are external to the institution. A director and their dedicated staff manage the daily operations of each facility. Each RSF is administratively located in a home division and receives monthly updates from their respective divisional business team. Within CCRF, a single central RSF administrator is responsible for overseeing and facilitating support for all billing operations, updates, training, and other activities that take place within the billing system. The RSF administrator also acts as the project manager and liaison between stakeholders who will be using the billing system.

Two implementation profiles

A move to action for centralizing billing

In 2013, each RSF was using their own billing processes, and the growth rate and size of CCRF RSFs were rapidly increasing. At this time, research administrators began to recognize the need to centralize ordering and billing processes to allow for accuracy and more transparency for RSFs, investigators, divisions, and administrators. Additionally, as CCRF was undergoing a rapid expansion in research, each RSF began

developing homegrown solutions for managing services and reservations to address these procedural discrepancies. The need to provide researchers across the institution access to RSFs with a one-stop system to request services and reservations was recognized.

Furthermore, it was important for the institution to implement a centralized billing system for all RSFs that ensured compliance in accordance with the OMB-A-133 guidelines and perform the annual rate reviews with accurate information. The added benefit of connecting RSF activities to our financial system reduced cogs in customer pipelines and implemented efficiencies that guaranteed compliance and best practices; therefore, the research administration began to review billing systems to address these needs.

The implementation plan involved several stages of development with transitioning groups of RSF into the new system in 4-to-6-month intervals. The decision to implement groups over a time interval of 4 to 6 months allowed for each group to have ample time to 1) learn the tools and functions of the centralized billing system, 2) share their workflow ideas and be guided on suggestions to implement their ideas, 3) evaluate their workflow processes within a testing environment, 4) evaluate feedback from customers and staff, and 5) develop a final workflow solution that worked for their RSF. The entire implementation process required 18 months of work and concluded at the end of 2015 (Table 1).

Table 1		
Stakeholder roles and responsibilities		
Stakeholder	Role	Responsibility
Software vendor of centralized billing system	Provide guidance on best practices and implementation planning with your institution.	Aid in training, data uploads, and connectivity with auxiliary systems; manage software updates; and continuing education to institutional liaison or CCRF administrator of RSFs.
Institutional accounting	Oversees the financial system for the institution in which the billing system will integrate with.	Ensuring financial transactions are received into the Source Financial System correctly and processes charges for internal and external customers correctly.
Institutional administration	Oversees the centralized operations and processes for RSFs.	Responsible for ensuring RSFs follow the same practices for billing, rate development, and policies set forth by the institutional and federal guidelines.

Information technology	Oversees and approves institutional software resources, reviews security and integration, and ensures SSO and technical connections between systems work.	Provide technical expertise on how to integrate communication between centralized billing system (billing and financial source systems), SSO, and security.
RSF director	Provides leadership and direction over the operations and process within their RSF.	Guides administration on what functions and features are needed for the ordering and scheduling workflows of their RSF.
Business manager	Responsible for managing the financial transactions for their division, includes PI grants and RSFs if they are present within their division.	Provide feedback on the development of reports and functions within the software that will enable them to perform job duties better.
End user/laboratory manager	A member of a research laboratory who typically requests services, training, or creates reservations with an RSF.	Provide feedback from an end-user perspective on the intuitiveness, functions, and features of the billing system for them to submit requests and track spending within RSFs.

The challenge of transitioning from multiple independently designed billing systems into a centralized, unified process created a culture shift for researchers and RSF stakeholders. The effort to migrate all RSFs to a centralized system required solid leadership and change management skills to address stakeholders' organizational and cultural concerns. The primary goal was to have all RSFs using a uniform platform and billing practices while conserving the autonomy they should have in determining their daily operations and procedures.

Migrating to a new software platform

In 2017, a corporate acquisition of the software platform first implemented in 2014 was announced, which lead to a search for a new centralized billing system software solution. A few more companies had added new software solutions to the market since our initial search in 2013 that were considered viable candidates. We determined our choice based on our ability to work with the vendor and software features available within the centralized billing system as well as input from key stakeholders, including administrators and RSF directors. Implementation of the selected centralized billing system began in the fall of 2019 and was expected to go live in July 2020. Our conversion to the new billing system occurred during the unexpected global COVID-19 pandemic that caused us to develop virtual online implementation strategies to stay on target with our transition plan and goals.

Planning for this transition involved many stakeholders (as seen in Table 1) from institutional accounting, institutional administration, information technology, RSF directors, division-level business managers, and some end users for testing. The timeline for this transition, shown in Table 2, was based on internal discussion and the desire to go live with the new system at the start of a new fiscal year, July 1. Discussions were held with the vendor prior to the launch of implementation initiatives, and preparation was focused on training and onboarding the project management team with using the centralized billing system and determining the roles and responsibilities for all stakeholders.

Table 2					
Comparison timeline of implementation					
Year of implementation	Type of transition (from – to)	Total time to completion	Number of transition cycles	Number of RSF per cycle	Total RSF
2014	Manual uploading/tracking – software	18 months	4	4 to 6	25
2020	Software – software	9 months	1	All (25)	25

We faced 2 significant challenges during the transition from one centralized billing system to another. The first challenge was embedded with how to manage 2 different billing processes from 2 distinct centralized billing system platforms. Since our user base was large (over 500 research laboratories), we wanted to avoid customer confusions as to which centralized billing system they should use to place an order and/or reserve an instrument during the transition from one platform to another. Towards achieving this goal, CCRF opted to convert the RSFs from one centralized billing system to another in a single go-live cycle. This was an aggressive transition that required extensive strategic planning and communication, as this type of implementation had not previously been attempted by the vendor or, to the best of our knowledge, any other institution. The second challenge was identifying various processes that could be transitioned from manual to more automated workflows that were not part of the previous billing system. These options were identified due to the new centralized billing systems' capabilities and as a group effort to self-recognize our current pain points within our institution as well as the desire to improve them further. Most of these processes enhanced our external customer experience and internal setup process.

Overall, the goal with each centralized billing system implementation (Figure 1) was to ensure we 1) aligned with CCHMC core values and the culture of our organization, 2) provided a seamless integration with existing

systems, and 3) aimed to achieve desired outcomes for all stakeholders. These goals remained the central focus for our implementation process, and we centered our strategy around these 3 aims.
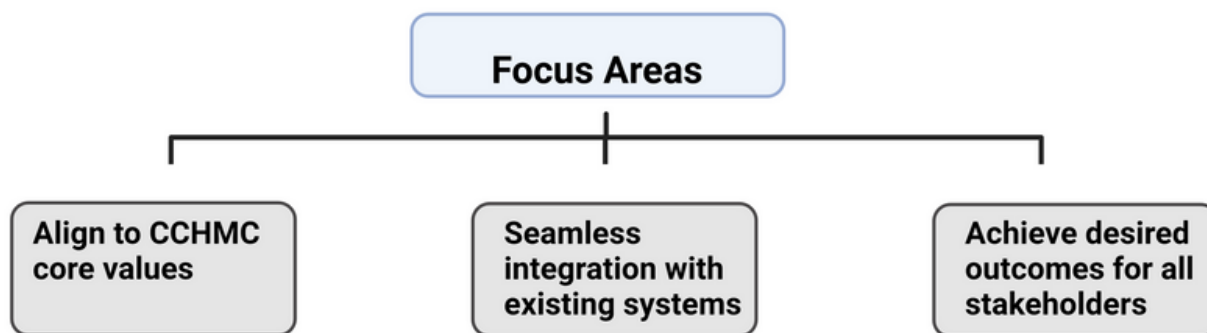

Figure 1

Goals of centralized billing system implementation planning. Outline of the goals used to strategize design and implementation of billing software.

Comparison of integrated processes in each implementation

The infographics in Figure 2, Figure 3, and Figure 4 demonstrate the progression of the workflows and integrations facilitated in each implementation iteration. Figure 2 demonstrates the different methods RSFs were using to collect billing data and sending individual files to research accounting for billing processing. The lack of transparency for research laboratories and divisions to understand the detail of these charges created additional need for RSFs to look up transactions for investigators and business roles on a case-by-case basis. Critical improvements were made with the implementation of our first billing system (Figure 3), which allowed for investigators to run reports on their usage and for research accounting to receive 1 file for all the RSFs. Additional improvements expanded into our second implementation of a new billing system to allow for the adoption of Application Programming Interface (API) for order entries (Figure 4). Additional improvements included the automated delivery of bookkeeping files to our accounting department and the addition of forms and milestone management in RSF workflows as well as the ability to automate the calculation of subsidies within the centralized billing system. This paper will continue to discuss some of the lessons learned through the implementation processes.

Figure 2
Pre-software workflow for centralized billing. Schematic highlighting the different methods RSFs were using to collect billing data and sending individual files to research accounting for billing processing.
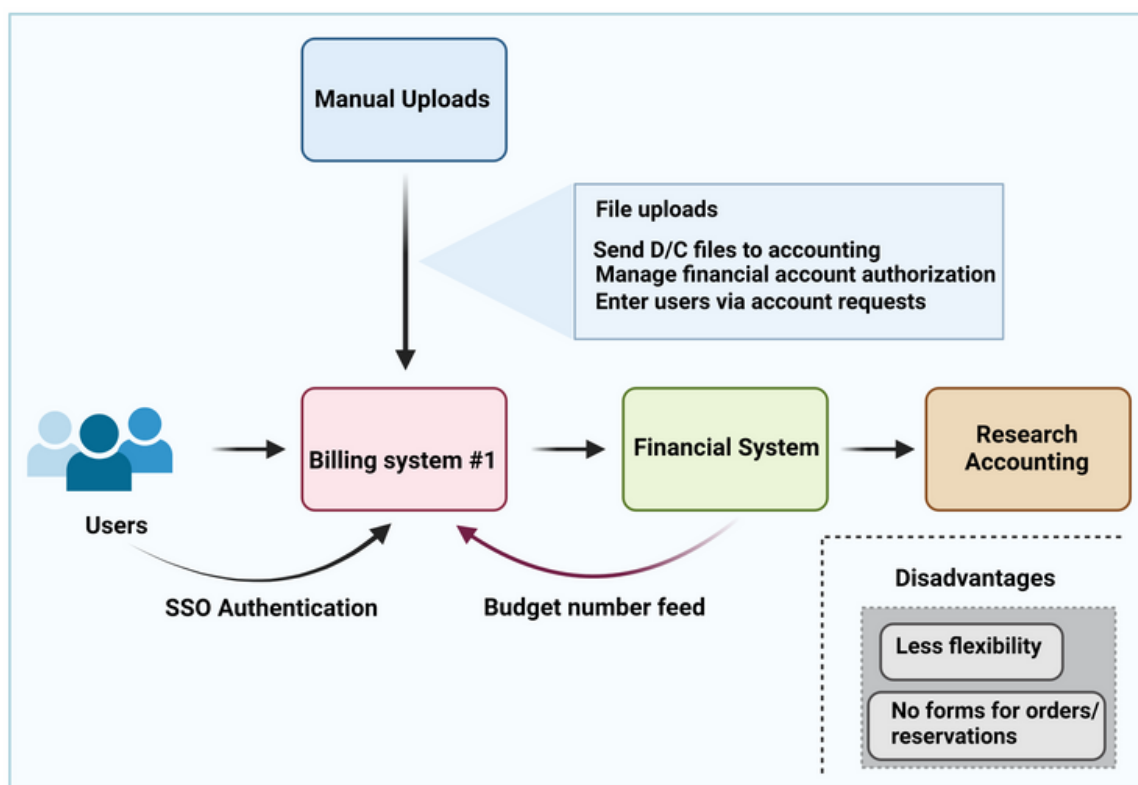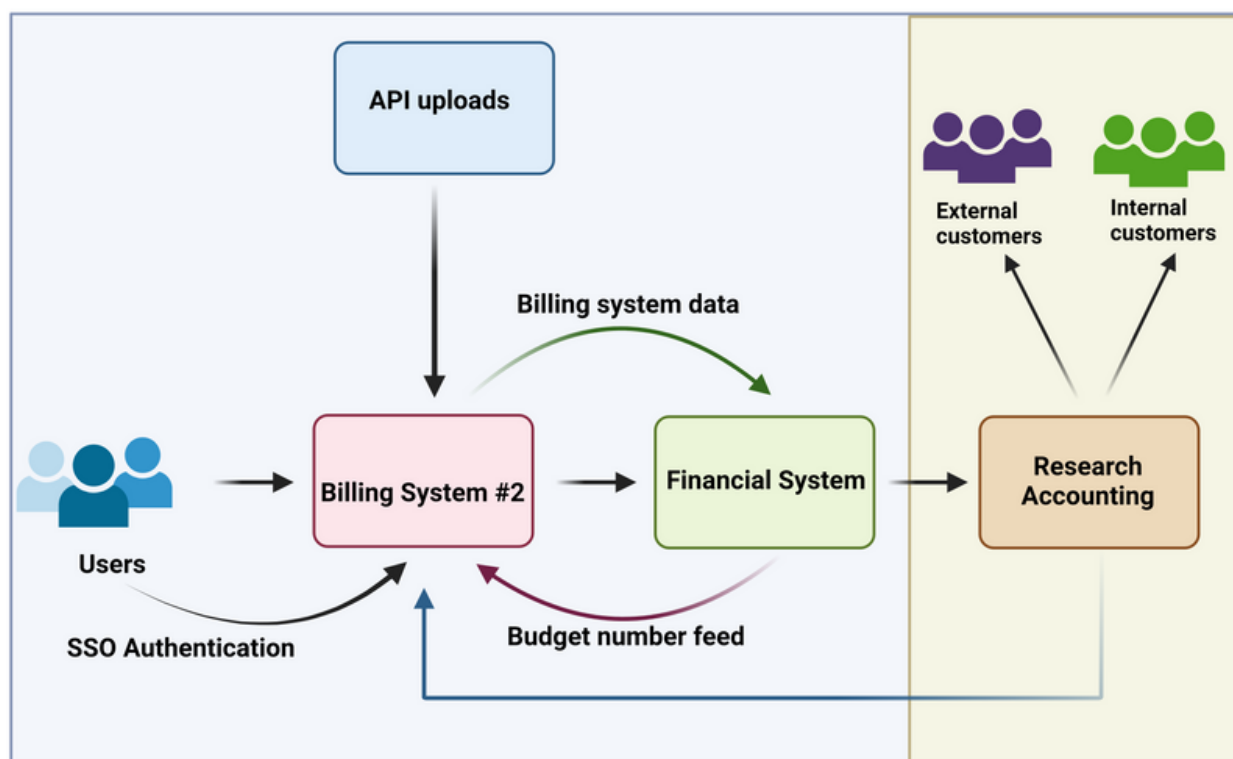

Figure 3
2014 software integration and workflow with other systems. Schematic highlighting the first set of improvements made in 2014 to the design and implementation of our first online centralized billing system. SSO, single sign on. D/C, debit/credit.

Figure 4
2020 software integration and workflow with other systems. Schematic outlining the improvements made in 2020 to the online centralized billing system.

LESSONS FROM IMPLEMENTATION EXPERIENCES

Organizational culture

Establish an essential team for implementation

For many institutions, a project manager may have been leading the process of selecting a centralized billing system up to this point. If resources allow, this person may continue to manage the project through the implementation phase and ensure the completion of all deliverables. If this is not possible, it would be advisable to allow the project manager ample time to acclimate themselves to the intricacies of the centralized billing system that is planned to be implemented. The project manager should be willing to serve as an expert in the software's features and gaps and the relevant needs of the institution at every level.

In addition to a skilled project manager, it is critical to identify a team of essential members who can work closely to provide feedback, expertise, and be involved in making critical decisions. In the absence of a well-orchestrated essential team, implementation will likely become cumbersome, inefficient, and error prone. When selecting members for the essential team, it is important to include representatives with diverse skill sets, areas of expertise, and vantage points. For example, while one person may bring excellent troubleshooting

ideas to the table, if a person with technical competency is not present, the feasibility of proposed solutions may require additional outside discussions that could delay decision-making and exceed timelines. For example, without a voice from research accounting, while discussing billing workflow solutions with RSF teams, decisions made by the team may implicate billing processes for research accounting stakeholders, reduce their awareness of how to aid in troubleshooting, and disrupt relationships by unexpectedly changing their expectations.

To ensure all areas are covered, consider including representatives from the following areas for stakeholders for your implementation team:

- Project management
- Research administration
- RSF directors
- Finance/accounting
- Business managers
- Manager of the NIH P30 grant
- Research/clinical investigators or laboratory members
- Information technology
- Vendor

Importantly, do not underestimate personality differences when assembling your team. It is critical to broaden your perspective at various points in the project, while other phases will require more attention to detail. Attempt to include personalities with different strengths: some members are excellent broad conceptual thinkers, while others excel with identifying all the details. Overall, members of the project team should share a commitment to working together constructively and respectfully.

When assembling the team, outline clear operating principles to ensure all meetings are productive and constructive. Be clear regarding the time commitments and expectations upfront to ensure all team members can allocate the necessary time to attend meetings and meet deadlines. Keep the team relatively small but diverse, as this will aid in efficient and comprehensive decision-making processes.

The vendor's role in implementation

The vendor is the expert on the design, features, functions, and limitations of the centralized billing system. Additionally, vendors have a plethora of experience in working with other institutions and therefore are a valuable resource for implementing training, creating guides, establishing processes, and developing timelines that are feasible. It is important for institutional stakeholders to discuss with the vendor their concerns and ideas and address the pragmatism of their goals so that a unified plan can be developed and agreed upon. The more congruence in expectations that can be developed, the better your relationship with the vendor will be and the quicker your implementation of a centralized billing system will occur.

Identify subject matter experts

If individuals are overly committed to other projects, but their expertise may be of great benefit, consider including them as subject matter experts (SMEs) instead of essential team members. SMEs can be present for specific discussions relevant to their area of expertise. These individuals will not be responsible for attending every meeting, and they will not have an active vote in final decisions made by the essential team. This should be made clear to potential SMEs upfront to help guide their decision of whether a role as an SME or essential team member would be more appropriate.

Overall, a centralized billing system is a software interface that will affect numerous members of your institution. As such, never underestimate the importance of having SMEs from each of these areas present during critical discussions to weigh in on how project decisions will interface with or impact their areas/departments. Examples of some of these SMEs that expand beyond the stakeholders above are listed below:

- Research administration
- RSF
- RSF business manager
- Manager of the NIH P30 grant
- Principal investigator
- Laboratory manager/member
- Business manager
- Finance/accounting
- Information technology
- Customer service expert

All key players are essential and should be present when important decisions are being made to contribute perspectives toward decisions. Creating a solution for a problem that arises can lead to a different issue for someone in another area. Involving subject matter experts will assist in alleviating any of these surprises by thinking through critical development issues from every perspective within the institution.

Be careful to advise that although SMEs will play an essential role in weighing in on important decisions, they will not have the authority to finalize them. This is the responsibility of the essential team. If an SME desires to be involved in the decision-making process, consider including them as an essential team member instead of an SME.

Meet regularly: Maintain transparency and regular communication

When laying out your Team Operating Principles, consider the importance of communication. Coordination between multiple departments and across various roles will require continued coordination. Maintain project

momentum by agreeing upon a regular meeting schedule for your essential team members, pulling SMEs, RSFs, or other parties to join as needed. Regular and consistent communication will help ensure that all issues are addressed in a timely fashion and keep the dialogue active. In many cases, an initial talking point will lead to a discussion on various other related issues, which may not have been addressed or encountered in the absence of a roundtable discussion among the group. The strength of your essential team and SMEs is one of your main assets; take advantage of this strength by holding regular meetings to benefit from the group of experts.

Standardize your implementation plan/have a timeline and action plan with milestone goals

How will you first choose which RSFs will be phased into the new centralized billing system? What guidelines are in place to decide which RSF will come next? How many RSFs will you roll into the system at a time? Will you meet with the RSF individually or as a group? What is your timeline for each "phase" of this process? Take the time to think through the answers to these questions *before* you get started. Then, list your project milestones, complete with a specific deliverable, responsible stakeholder, data, acceptance criteria, and evaluator who authorizes the material for implementation.

- Develop milestones
- Specify deliverables
- Define due dates
- Assign stakeholder responsible
- Outline data acceptance criteria
- Evaluator (who will be the judge of whether this is complete)

Example:

- Establish guidelines for RSF selection. For example, try to group RSFs with similar workflows (eg, equipment booking) together to maximize the efficiency of training RSF staff and users.
- Contact the first set of RSFs and obtain their acceptance.
- Set up one-on-one meetings with each of the phase I RSFs.
- Develop a workflow for ordering and placing reservations in RSF.
- Collect the final item and pricing list from each phase I RSF.
- Create test sites for each phase I RSF, and meet to discuss progress.

- Begin phase I group meetings weekly to discuss general topics
  - Week 1: Introduction, a reminder of item/resource maintenance, templates, and status updates.
  - Week 2: Place parallel orders in a parallel test system to ensure workflow requirements for each RSF are met and discussed where necessary. Ensure RSF user permissions, reports, and customer feedback on the workflow are also received.

- Week 3: Address the billing workflow, including budget number corrections, invoices, refunds, and subsidies.
- Week 4: RSF training and customer training.

Be realistic in your timeline

When laying out your project deliverables, set realistic goals for each project phase. Pressuring departments to adapt to a new system before they are ready will increase anxiety amongst your users and create a negative impression of the system. However, being too flexible on your timelines may also encourage procrastination and decrease morale. For example, if the go-live date for your first 2 groups of RSFs is pushed back by a month, the third set of RSFs will quickly assume that your deadlines are flexible. This might reduce the motivation to stay on track with their objectives. Instead, attempt to set feasible timelines and stick to them whenever possible.

In our experience, with today's busy schedules, most members of your RSFs will have numerous other, often higher priority commitments that require their focus. Due dates often dictate the priority level on an individual's to-do list. Listen to your users and accommodate their time constraints, but also remember that if you have set reasonable deadlines, stick to them.

Learn from your mistakes/be attentive to feedback

Once you have successfully implemented the new system, take the time to reflect on those experiences and optimize your implementation plan. For example, were one-on-one meetings with each RSF the most efficient way to be acquainted with the centralized billing system and understand their needs? If so, you may want to forego initial group meetings for one-on-one discussions and then meet as a group later once everyone is more comfortable with the new system and how it will affect their day-to-day operations.

Standardizing the process of identifying candidates and assisting their transition into the new centralized billing system will ensure that the process is efficiently moving forward and staying on track. Feel free to encourage members of newer RSFs to reach out to those already using the centralized billing system to benefit from their experience and perspective. Ask for feedback from groups in previous phases to gather their input on how the process could have been improved.

Overall, it is never too late to learn from your mistakes and improve your process, so do not hesitate to take advantage of this opportunity and streamline your implementation process.

Be positive, and do not forget the importance of customer service, centralized resources of information and guides, websites, and websites with a dedicated support team to facilitate questions and assistance.

One of the driving forces behind implementing a centralized billing system is to improve efficiency, clarity, and experience for the end user. Whether this is a customer, an RSF staff member, a member of research

administration, a manager of the NIH P30 grant, or a business manager, your new centralized billing system should be a solution that improves their daily workflow. Ensuring that all end users have a pleasant and seamless transition from their current practices into the new system is of utmost importance. Furthermore, having a comprehensive foundation of customer service features in place is critical to the success of your implementation and, more importantly, the morale within your institution relating to the adoption of the new centralized billing system. Here are some essential points to consider providing as a resource to support your end users:

- Centralized sources of information
  - Website
  - Training guides
  - Tutorial presentations
  - Details specific to bringing each RSF live in the new system
- A dedicated support team ready to facilitate questions, hold training sessions when needed, troubleshoot potential glitches, and assist with end-user issues
  - Regularly scheduled training sessions
  - Contact phone and email, staffed with dedicated personnel

Stakeholder Experiences in Implementation

Shared facility perspective

Order- and reservation-based RSFs

Order- and reservation-based RSFs typically have an interface within their billing system to allow for customers to 1) reserve time on a calendar for an instrument in which they are trained on or need assistance with using and 2) place orders to request a service such as the purchase of a reagent, histology service, software license, etc. During the first centralized billing system implementation process, a considerable amount of time was focused on identifying ideal workflows for order and reservation requests. The time spent optimizing the workflows during the first implementation stage helped to align the needs of the RSF and improved the alignment of administrative goals. This optimization of the order and reservation request workflows subsequently carried into the second centralized billing system implementation project.

The mitigation of issues was facilitated with careful planning and thorough testing of workflows during both implementation projects. However, the most remarkable improvement for RSF management was during the first centralized billing system implementation that allowed RSFs to move from error prone Excel-based tracking and billing to a single platform that allowed for the collection of accurate financial accounts, transparency for the staff to manage and facilitate customer needs, and less manual entry in a single system.

The RSF perspective of this transition voiced several challenges in migrating from one centralized billing system to another. Most of these challenges were associated with the global pandemic during our transition. However, there were some benefits of adopting a new system during this period.

Challenges included 1) researchers learning the new system, 2) ensuring forms that capture all the information necessary for the service, and 3) RSF and business staff learning the new system. In addition, benefits included 1) the ability to leverage the use of forms not previously available in the first system, 2) new calendar features that increased availability and allowed for better management of access to users, and 3) increased seamlessness in the overall billing process.

Timed entry–based facilities

Time-based facilities include RSFs that do not have instrumentation or cellular bench projects that help drive and determine their service cost. Instead, time-based facilities are those that provide data analysis, project oversight, planning, and development by the need for consultation, design work for animations or illustrations, etc. Examples of these RSFs are data managers, biostatistics, informatics, and media. These RSFs charge based on the time spent contributing to a service that a researcher needs assistance with and the need to document how much time was spent working on the project.

The challenge with this transition was encouraging a culture shift adoption to documenting time spent on projects within a computer system that associates activity with a budget number. However, not all RSF personnel are aware of which budget number to select for their time. Careful discussion and coordination need to be developed to address these questions. Additionally, the time tracking software available was clunky and required too much clicking to log activity on a project. As a result, a different centralized billing system was set up that was easier for RSF personnel to use, and an API was established to connect the time-based activity to the billing information in our centralized system, which business personnel could manage and oversee.

Project-based facilities

A significant advantage of switching to a centralized billing system from manual processes and rudimentary software-based systems for managing customer orders and tracking projects was automating multiple aspects of the workflow. However, it was often challenging to see exactly how the nuances of existing workflows would transition to the new centralized billing system. This resulted in some of the software resource capabilities requiring modification/updates after implementation once customers and RSF staff began using the system. In addition, the RSF staff did not recognize some of the capabilities of the new centralized billing system during training and testing. This emphasized the importance of being flexible in training and, most importantly, access to a sandbox environment in which RSF staff can test the functionalities of the centralized billing system. Finally, it was critical to have a dedicated support team that could rapidly and efficiently respond to changes or functionality implementation requests. Ultimately, using a centralized billing system for

project-based RSFs has multiple benefits, including streamlined communication and access to up-to-date project status information for customers.

Subsidy management perspective

At CCHMC, there is a dedicated manager for the NIH-funded P30 grant that provides subsidies for services at the RSFs to the center members. The P30 manager is responsible for oversight of subsidy distribution to its members on eligible research projects. The overall transition from one centralized billing system to another provided new tools and resources that allowed for the automatic calculation of subsidies. The management of eligible subsidy criteria within the new centralized billing system resulted in streamlining the process of applying the subsidy criteria to services, RSF usage reporting, and subsidy tracking by center members.

Laboratory member perspective

The user interface for laboratory members and investigators was simple and intuitive on both platforms. Transitioning from one centralized billing system to a new one demonstrated added features that benefited the end user and increased their ability to place orders and reservations that required more detail without multiple emails or phone calls. With a single login or single sign on, users could access all RSFs at once. Workflows created for the end user were also intuitive enough that extensive training for onboarding users into the new system was unnecessary.

TECHNICAL CONSIDERATIONS

Financial and authentication management systems

While collecting centralized billing system requirements and screening vendors in the early stages and later during gap analysis, be conscious of the current centralized billing system that is being used by each RSF. It will be essential to determine if your vendor allows the flexibility to interface with your current systems. If an API is possible, plan time for the logistics. If this is not possible, plans for how the RSF will transition from its current software to the new system must be in place. A few options are as follows:

- API to allow current software to interface directly/feed into the new system
- Maintain 2 systems: export from system one and upload into system two
- Abandon the current system; set up a new system to handle those requirements as well

User login validation

For our purposes, federated authentication allowing users to log into the new system with their standard institutional username and password was an important consideration. This is another instance in which ample time should be allocated. In most cases, it will be necessary to employ members of information services or other departments to implement this feature. From our experience, it was critical not to underestimate the time

frame required for members outside of the essential team to allocate the necessary time and resources to your project.

Budget number feeds

If you would like your institution's financial system to feed into your new centralized billing system to ensure that budget number information is accurate and up to date, be sure to allocate sufficient time to set this up from a technical perspective. Important considerations are as follows:

- Format of your institution's budget numbers
  - What components are essential? Redundant?
  - Does a given RSF have >1 account to receive payments?
    - What dictates which account is selected?
- Character limitations within fields
  - Are there character limits that impact information from one system being accepted by another?
- Internal versus external account workflows and processes
  - How are external customer-issued financial accounts for billing compared to internal customers?
  - How does this access impact billing and ordering workflows within the centralized billing system?
- Software limitations in budget number assignments and access
  - How are individuals given/removed from having access to specific budget accounts within the system?
  - Who is responsible for managing user access to budget accounts within the system?
- Budget number ownership
  - Does your financial system assign budget numbers to investigators, business directors/managers, etc.?
  - Does this mirror how these budget numbers are assigned in your centralized billing system?
  - How are internal budget accounts issued to users compared to grant-funded budget accounts?

Manual or API-facilitated order uploads from in-house and third-party software

If current systems are maintained for managing order entry, those systems will need to be developed to export the relevant data into a file format that can be uploaded into your new centralized billing system using either manual or API workflows. Identify who is responsible for developing and maintaining the current system to ensure that this person or team (preferred) has the resources and means necessary to contribute to your project. Clear and concise communication is required regarding the data that needs to be pulled, the file format, who is responsible for pulling the data, who is uploading the data, and the schedule for completing the tasks. It is critical to think about the suitability of changes made between the 2 systems. Establish a standard operating procedure outlining who is authorized to make changes and which interface changes are to be made, and develop an identifiable solution that adheres to changes that remain auditable.

Systemic workflow

Process mapping is critical for designing successful execution methods for a large-scale project such as centralized billing system implementation. The current processes, the vision for change, and the needs to facilitate those workflow changes are critical. This information for all stakeholder perspectives involved in this process will take time but will create a robust and sustainable solution for your implementation planning that will prevent you from making changes after your go-live date. Facilitating or making changes to your system after it has gone live can impact customer workflow, reporting outcomes, and data reconciliation across time. Time to plan, discuss, and identify the strengths and weaknesses of each decision-making point will prevent significant postimplementation changes or revamps to workflows.

Ordering process: RSF and user perspectives

The first step in accurately meeting the needs of an RSF within the new centralized billing system is to completely understand their existing workflow. Initial meetings aimed at process mapping are beneficial for successfully translating processes into the new centralized billing system. In our implementation plan, it was helpful to meet with each RSF individually to understand their current processes. Ask the RSF manager to walk you through the ordering process from start to finish, beginning with how their customers interact with the RSF through service completion and invoicing of the order. Pay close attention to current order forms, web forms, websites, and training guides that they may have in place. These will need to be carefully integrated or transitioned/mimicked in the new centralized billing system. Some key considerations or helpful discussion points are highlighted below:

- What is the customer's first interaction with the RSF: email, phone call, online?
  - Does the RSF have a website with valuable instructions or links for customers?
- Does the RSF use an order form? Electronic or paper?
- How does the customer communicate which budget number should be charged?
  - Are there any checks and balances to confirm that the correct budget number is provided?
- Does the service involve scheduling time on a resource?
  - Where are schedules currently managed, and by whom?
  - Can the user export their appointments to a personal calendar?
- Are detailed files of sample names or data required at the point of order entry?
  - Can the new centralized billing system handle/facilitate this data capture?
- Does the customer *know* the details of the order they need to place, or does order entry require a consultation with the RSF as a first step?
  - Who is responsible for entering the order? Customer or RSF staff?
  - Are there different order forms/templates for different types of orders for this RSF?
- Are there levels of details required for order processing that need to be collected but do not affect the price?

- How is that level of detail currently collected? Email, phone conversation, excel spreadsheet from the RSF's website?
- Does the RSF have a clear list of items, services, instruments/resources, and correlated pricing?
  - Is this correctly advertised on their website?
  - Are some items, services, etc., grouped for different types of projects?
    - Are there different order forms/templates depending upon the type of order?
- Once the order is submitted, is the customer updated on the order's status throughout the process?
- How is the customer alerted when the order is finalized?
- Does the RSF have an interface for distributing or storing data for the customer?

Billing cycle: Invoices, refunds, subsidies

The second step in evaluating the workflows within the new centralized billing system is to understand how transparent billing processes can now be facilitated. Identifying a person who is authorized to address billing issues such as budget account number changes and amendments to orders and reservations that results in refunds or corrections on an invoice should be considered. As previously mentioned, all these changes made in the centralized billing system to an invoice need to remain auditable and reportable if questions arise on why specific changes were made within the system. Key considerations or helpful discussion points for facilitating the distribution of invoices, refunds, and applying subsidies are highlighted below:

- Pre-invoicing
  - Should you include a time frame for your investigators and business managers to review pending charges before they are finalized?
  - How long should your charges be in this stage before they are finalized?
  - What changes can be made during this stage of the billing process?
  - Who should be able to make changes during this stage of the billing process?
- Budget number corrections
  - Who can authorize these adjustments?
  - When should they occur? Any time of the month? During or after pre-invoicing?
- Refunds
  - How should refunds be processed within the system?
  - What system is going to facilitate the refund? This is important to consider if you are working with multiple user interfaces.
  - When will refunds need to be processed before they are sent to accounting?
  - Who can process refunds within the system?
  - How are your refunds going to be traced back to the original order? Who and why was the refund processed?
- Subsidies

- How will subsidies be applied to orders and reservations within the system?
- What determines who is eligible for a subsidy?
- How will refunds be applied to orders if a subsidy was utilized?
- How will subsidies be displayed on orders, invoices, and a report within the system?

Reporting needs: Usage, invoicing, finance

Finally, understanding what stakeholders need and how the information will be extracted and analyzed from your centralized billing system should be outlined. Identifying essential fields of information and collating it from the system into a report takes time to develop as information accrues within a system. Generally, commonly shared reports are available that will benefit all stakeholders, but occasionally, a need may arise for a customized report to be established for a specific stakeholder or use case. Identifying if the centralized billing system can create custom reports or if your information services team can assist with developing this process is a vital evaluation point to consider in the selection process of your centralized billing system.

SUMMARY

This paper outlines some strategies and considerations when implementing a centralized billing system to track and manage RSF activities. Two transition processes are shared and discussed. The outcome of our experiences in migrating from 1) manual processes to a centralized billing system and 2) a centralized billing system to a second centralized billing system demonstrate that similar considerations need to be made when planning, designing, and managing a centralized billing system implementation. The most beneficial finding from our experiences with managing a centralized billing system implementation is to be mindful that you are implementing a tool that requires a mind shift of how things work to assuring individuals that this transition will allow things to improve workflow and minimize work. Establishing good relationships are critical, as trust needs to be developed by providing opportunity for everybody's concerns to be heard and addressed. When this is accomplished, the reward of spending time to plan, thinking methodically through a plan, and establishing relationships and trust among team members far outweighs the potential of disruptions that pause your implementation process. Taking the time to learn the needs and listen to the questions from team members during the planning process will allow for a more sustainable tool that everybody will use and create more motivation to execute the actual implementation plan.

ACKNOWLEDGMENTS

References

1. Chang M, Grieder FB. Sharing core facilities and research resources—an investment in accelerating scientific discoveries. *J Biomol Tech* 2016;27(1):2. ↩

2. Gould J. Core facilities: shared support. *Nature* 2015;519:495-496. ↵

3. Lippens S, D'Enfert C, Farkas L, et al. One step ahead: innovation in core facilities. *EMBO Rep* 2019;20(4):e48017. ↵

4. Meder D, Morales M, Pepperkok R, Schlapbach R, Tiran A, Van Minnebruggen G. Institutional core facilities: prerequisite for breakthroughs in the life sciences. *EMBO Rep* 2016;17(8):1088-1093. ↵

5. Carter JR, Delahanty DL, Strasser JE, et al. Operational and fiscal management of core facilities: a survey of chief research officers. *J Res Adm* 2019;50(3):14-31. ↵

6. Haley R. A framework for managing core facilities within the research enterprise. *J Biomol Tech* 2009;20(4):226. ↵

7. Hockberger P, Meyn S, Nicklin C, Tabarini D, Turpen P, Auger J. Best practices for core facilities: handling external customers. *J Biomol Tech* 2013;24(2):87. ↵

8. Hockberger P, Weiss J, Rosen A, Ott A. Building a sustainable portfolio of core facilities: a case study. *J Biomol Tech* 2018;29(3):79. ↵

9. Mays L, White AN. Lessons learned: a guide for implementing and activating a centralized billing system. *J Biomol Tech* 2014;25(Suppl):S12. ↵

10. Rupert A, White AN, Wagner M, Thornton S, DeLay M. Evaluation of billing and tracking programs leads to a hybrid approach. *J Biomol Tech* 2014;25(Suppl):S10. ↵

11. *Circular No. A-133*. Office of Management and Budget. June 27, 2003. Accessed July 19, 2022. https://georgewbush-whitehouse.archives.gov/omb/circulars/a133/a133.html ↵

12. *Circular No. A-133*. Office of Management and Budget. June 27, 2003. Accessed XXX. https://georgewbush-whitehouse.archives.gov/omb/circulars/a133/a133.html ↵

13. Kusy M, Holloway EL. A field guide to real-time culture change: just "rolling out" a training program won't cut it. *J Med Pract Manage* 2014;29(5):294-303. ↵

14. Rouda RH, Kusy ME. Needs assessment: the first step. *Tappi J* 1995;*78*(6):255. ↵